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WATER QUALITY EVALUATION OF THE BLUESTONE PROJECT, COLORADO

Federal Water Pollution Control Administration
San Francisco, California

December 1969

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WATER QUALITY EVALUATION OF THE BLUESTONE PROJECT COLORADO

An evaluation of the Bureau of Reclamation's proposed Bluestone Project reveals that with adequate treatment municipal, industrial, and other minor waste loadings will not significantly affect water quality for present and projected water uses in the Project area. Therefore, no storage in Mt. Logan Reservoir is needed to provide flow regulation for maintaining satisfactory organic water quality in the Colorado River. The use of Project water for irrigation, municipal, and industrial purposes will result in a 2.8 mg/l increase annually in the total dissolved solids concentration of the Colorado River at Lake Mead. The economic impact of this salinity increase upon water users below Lake Mead is estimated to be $112,000 annually, based on 1968 economic conditions. This appraisal provides an estimate of the effect of salinity increases resulting from the Project and will be useful in evaluating and justifying control measures for water quality improvement. Control measures are recommended for incorporation into the construction and development of the Project to minimize the adverse effects of salinity.

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U. S. Department of the Interior
Federal Water Pollution Control Administration
Pacific Southwest Region
San Francisco, California

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I. INTRODUCTION

This water quality evaluation has been prepared for the Bureau of Reclamation, Region 4, U. S. Department of the Interior, Salt Lake City, Utah, for inclusion in their feasibility report for the Bluestone Project, Colorado. The primary purposes of this evaluation are:

1. To determine the need for and value of separable reservoir storage for streamflow regulation to control water quality;

2. To assess the overall impact of the proposed development on water quality, both in and outside the Project area; and

3. To recommend, where applicable, water quality control measures for the project.

The evaluation was made of the effect of the Project now and in the year 2010 in the Roan Creek drainage area in West Central Colorado and in downstream areas of the Colorado River Basin.

This report has been prepared under the authority of and in accordance with provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) and Executive Order 11288, dated July 2, 1966, at the request of the Bureau of Reclamation. Section 3(b) of the Act requires that consideration shall be given to inclusion of storage for regulation of streamflow for the purpose of water quality control, except that any such storage shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source. Executive Order 11288 clarifies the purpose of Section 11 of the Act. Section 1(7) of the Executive Order requires consideration of water pollution control needs in the initial stages of planning for each new installation or project.

Basic data for this evaluation were supplied by the Grand Junction Project Office, Region 4, Bureau of Reclamation. The assistance and cooperation given by the Colorado Department of Public Health and the U. S. Fish and Wildlife Service is also gratefully acknowledged.

The proposed Bluestone Project is located along the Colorado River and a tributary, Roan Creek, in parts of Garfield and Mesa Counties in West Central Colorado (see Figure 1). The Project will provide water for irrigation, municipal and industrial (M&I), fishery, and recreational purposes. Surplus flows of Roan Creek will be diverted to Mt. Logan Reservoir. Water for irrigation will be released into the Mt. Logan Canal for distribution to existing ditches. The Kobe Pumping Plant will be constructed on the Colorado River to provide adjacent lands a continued full supply through the Kobe Lateral. Roan Creek water presently used on these lands will be available for exchange upstream. Water will be pumped from the Colorado River to the Sharrard Park area.

II. PROJECT IMPACT ON WATER QUALITY

In order to evaluate the impact of a water resources development project on water quality, it is necessary to examine the various factors that influence water quality. The economy and water supply in an area affect the amount and type of water use. It is necessary to develop data on the present and projected economy of the study area in order to estimate future municipal and industrial use of project water and the resulting waste loads. The same economic and demographic data may also be useful in evaluating any water quality control measures incorporated into the project plan. The water use influences waste sources and the quality of water downstream from the point of use. Any change in the quality of water has an economic impact on all downstream water users.

The relationship between water use and water quality is illustrated in Figure 2. Water is diverted by User 1 at "A" and the unused water including wastes is returned to the stream at "B". The quality of water at the next downstream diversion "C" is affected by the quality of water at "A", the depletion of streamflow by User 1 and the quality and quantity of water discharged at "B". Streamflow depletion by User 1 affects quality at "C" by reducing the volume of streamflow available for assimulation of wastes entering the stream in reach B-C.

LOCAL ECONOMY

Agriculture is the only significant economic activity in the project area. Principal crops grown are alfalfa, barley, and pasture, as well as some orchard crops such as cherries and apples. All of the potential supplemental-service lands and the greater part of the full-service lands are privately owned. The irrigable project area is held in 37 ownerships. No significant changes in the type of farming are expected to result from the Project; however, better crop yields are expected on supplemental-service land. This increase, along with crops on new lands, should lead to expansion and stabilization of the livestock industry as well as cash-crop farming.

Large reserves of oil shale are present in the region. Ten or more oil companies own oil shale lands in the vicinity of the Project. One of the prime requisites for the emergence of an oil shale industry is an adequate water supply. One oil company has estimated that 6,200 acre-feet (A.F.) of water would be required annually, with no return flow, to support a plant with a production capacity of 50,000 barrels of shale oil per day. This estimate does not include domestic and municipal water requirements for the employees and their families, nor does it include any water for the associated service population that would accompany an oil shale industry.

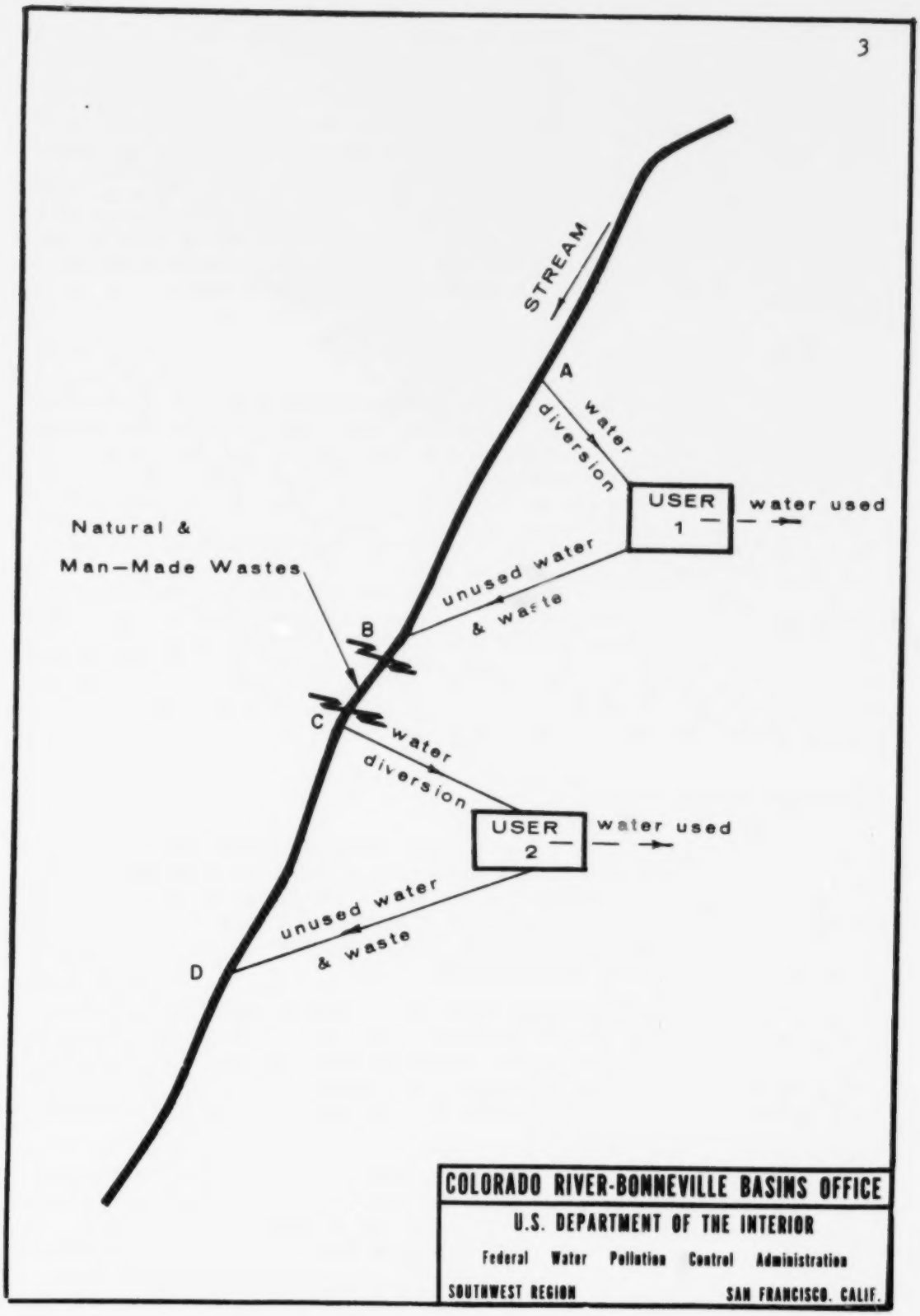


Figure 2. Effect of Water Use on Stream Water Quality

The present population of the Bluestone Project service area is about 500 people. Estimates of population increase due to oil shale development vary considerably. Various published reports indicate that a population increase of 400,000 people in western Colorado is conceivable by the year 2020. The amount of water allocated for municipal use by the Bluestone Project will support a population of 70,000 people based upon a Bureau of Reclamation per-capita use assumption of 300 gallons per day. Therefore, for purposes of estimating waste loadings, a population of 70,000 is forecasted in the Bluestone Project service area.

WATER SUPPLY

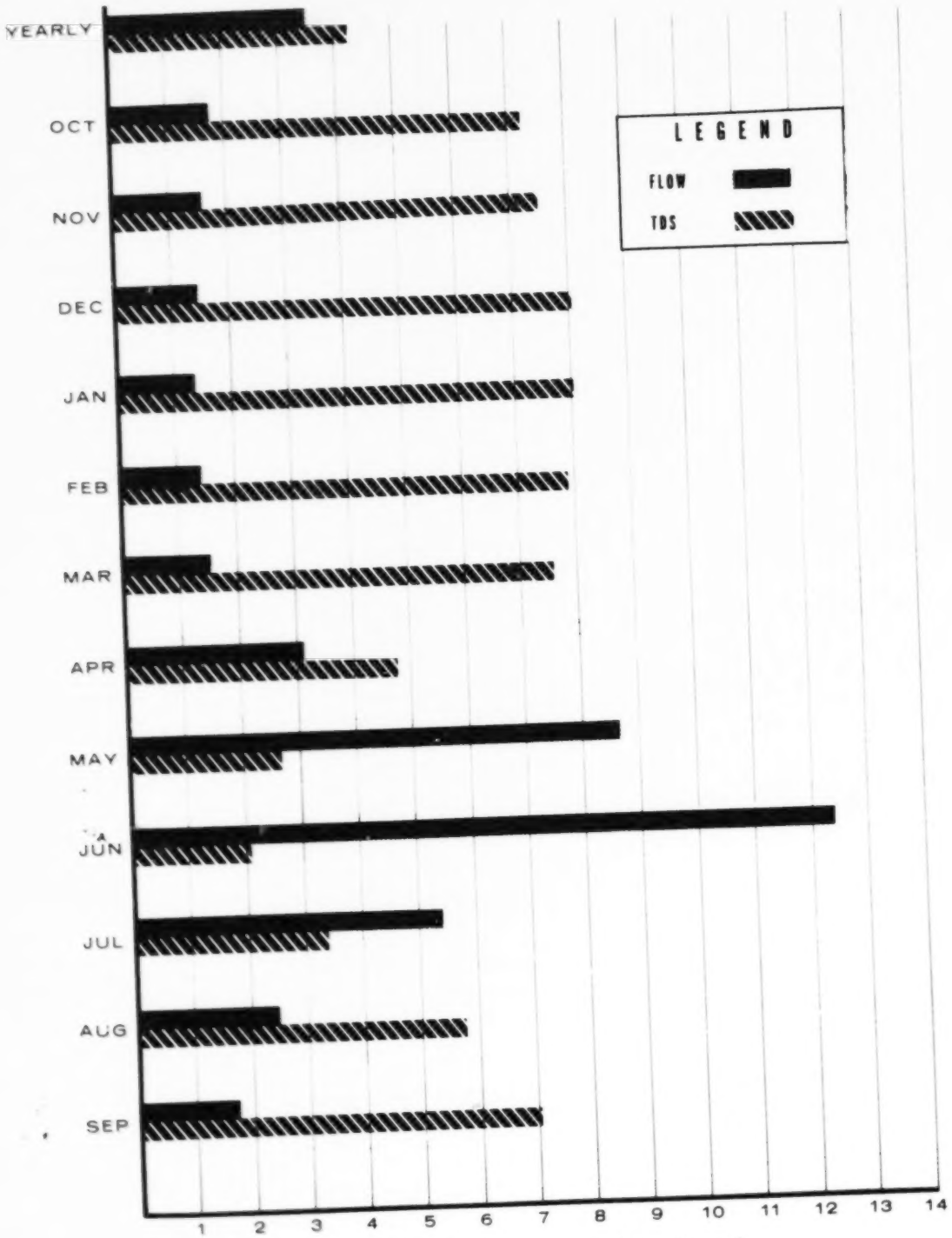
Water supply in the Project area is related to two streams: Roan Creek and the Colorado River. Roan Creek, the source of water for the proposed Mt. Logan Reservoir, originates in the Roan Plateau and has a reach of about 30 miles before it enters the Colorado River. The Bureau's Project operations study shows the annual flow of Roan Creek to be 34,100 A.F. at the diversion point for the Mt. Logan Reservoir. The present (1966) modified average annual flow of the Colorado River at Cameo, Colorado, is 2,636,000 A.F.(1) which is representative of the flow past the Project area. Transmountain diversions of about 450,000 A.F. are made upstream from Cameo. The present modified average monthly and yearly dissolved solids concentration and flow of the Colorado River at Cameo, Colorado, are shown in Figure 3. The present modified flow of the Colorado River at Hoover Dam is 10,291,000 A.F. The Project will deplete the Colorado River by 23,900 A.F. resulting in an annual flow of 2,612,100 A.F. at Cameo and 10,267,100 A.F. at Hoover Dam.

WATER USE

The natural flows of Roan Creek and its tributaries are used primarly for irrigation. Alfalfa, small grain, and pasture are produced on about 4,800 acres within the Project area. A marginal habitat for trout exists in the upper ten miles of Roan Creek. The fish habitat in the lower portion of Roan Creek is poor because much of the natural streamflow is diverted for irrigation.

The only use of Colorado River water in the Project area is for a municipal supply for the town of DeBeque. The temperature of the Colorado River in this area falls in the transition zone between cold-water and warm-water fisheries and, therefore, the stream is not very satisfactory for either. In addition, the turbidity of the river limits fish productivity.

Above the Project area, the main use of Colorado River water is for irrigation. The amount of water used for domestic, municipal, and industrial purposes is small compared with the available supply. Between the Project area and Lake Mead, Colorado River water is used primarily for



Yearly & Monthly Averages for the Years 1942 – 1966 from USGS Data

Figure 3. Present Modified Flow & Tota! Dissolved Solids Concentration of the Colorado River Near Cameo, Colorado

irrigation in the Grand Valley Irrigation District, an important fruit-producing area. Hydroelectric power generation at Glen Canyon Dam is another major use. Below Lake Mead, Colorado River water is diverted for irrigation, municipal, industrial, livestock, and hydroelectric power generation uses with irrigation use being predominant.

The Project will supply annually 1,500 A.F. of irrigation water for 4,020 acres of presently irrigated land in the Roan Creek Valley. Of this total acreage, 800 will receive a full supply while the remaining 3,220 will receive less than a full supply. About 500 A.F. will be supplied by the Kobe Pumping Plant to lands presently receiving water from Roan Creek. Sharrard Park will receive 2,700 A.F. of irrigation water for full service to 750 acres of new land. Anticipated industrial and municipal development (for oil shale) in the Sharrard Park area will receive 55,000 A.F. from the Colorado River. Mt. Logan Reservoir will supply 6,000 A.F. of municipal and industrial water to the Roan Creek area. Thus, a total of 61,000 A.F. of M&I water will be provided, of which 37,000 A.F. will be for industrial use and 24,000 A.F. for municipal use.

The Project will have little effect on the fishery in either Roan Creek or the Colorado River. The trout fishery of Roan Creek is mainly above the point where water will be diverted to Mt. Logan Reservoir; however, the reservoir is expected to provide a trout fishery.

WASTE SOURCES

The town of DeBeque produces the only domestic waste in the Project area. Presently this waste is treated by individual septic tank facilities and does not reach Roan Creek.

The sediment concentration of the Colorado River at Cameo is frequently relatively high, which has an adverse effect on aquatic life as well as municipal, industrial, and irrigation uses of the water.

Nutrients, pesticides, herbicides, heat, and radioactive substances discharged to basin streams are emerging water quality problems in certain areas in the Colorado River Basin. However, these water quality problems are not expected to be significant in the Project area.

Salinity (total dissolved solids) is the major water quality problem in the Roan Creek area. Two factors associated with irrigation cause stream salinity concentrations in the area to increase. First, water is lost by evapotranspiration with no accompanying loss of salt, thereby causing salinity concentrations to increase. The pickup of salts from irrigated lands in excess of quantities required for maintaining a salt balance is the second factor causing an increase in salinity.

The present salt load in the Colorado River near Cameo originates from natural sources and from activities of man, principally irrigation. Two of the major natural sources are Dotsero and Glenwood Springs (includes Yampa Spring), which together contribute approximately 500,000 tons of salt annually to the river system. These saline springs account for about five percent of the salt load discharged into Lake Mead.

Future wastes in the Project area will result in an increase of the salt load in the Colorado River system. W. V. Iorns[2] estimated that in the Project area irrigated lands will contribute five tons of salt per acre to the river system. A study of the salt-load budget in the Roan Creek Valley made by the Colorado River Basin Water Quality Control Project shows that salts are not now being leached out of presently irrigated lands. Lack of sufficient irrigation water throughout the growing season has not permitted the application of required leaching water. With a full supply of water, the salts should begin to leach out. In estimating the TDS load caused by Project irrigation, it was assumed that both new and supplemental lands receiving a full supply of Project water will contribute five tons of salt per acre. This will result in an additional 7,750 tons being added to the river system annually. The Iorns report also states that a municipal water use will add about 100 tons of salt annually per 1,000 population. Thus, with a projected population of 70,000 in the Project area, 7,000 tons of salt will be added to the river system. It is assumed that the oil shale industry will use 37,000 A.F. of the 61,000 A.F. of project-supplied water. The many complexities and uncertainties involved in the development of an oil shale industry make it difficult to predict the salt load from this source. Past studies have shown that each pound of spent shale contains 0.00818 pounds of soluble salt[3]. With 100 percent control of saline waste, no salt will be added to the Colorado River.

Municipal water supplied by the Project is expected to support 70,000 people. The projected domestic waste load associated with this population would be 2,100 pounds of the five-day 20° C. biochemical oxygen demand (BOD_5) per day. This loading is based upon the following assumptions: (1) each population equivalent contributes 0.20 pounds per day of BOD_5, and (2) the Project area will always have waste treatment plants capable of removing 85 percent of BOD_5.

The recreational use expected at Mt. Logan Reservoir is estimated to be 50,000 recreation visits annually. This use constitutes a potential pollution problem that, if not properly controlled, could create water quality degradation both in the reservoir and in downstream reaches of Roan Creak.

WATER QUALITY

The major characteristics which determine the suitability of water for irrigation are the concentrations of total dissolved solids and boron,

and the relative concentration of sodium to other cations (sodium adsorption ratio). Waters of both the Colorado River and Roan Creek have been demonstrated by past use to be suitable for irrigation of crops presently grown. However, mineral quality records for Roan Creek at the proposed diversion point to Mt. Logan Reservoir are not adequate to determine the quality of water that will be diverted to the reservoir. The sodium adsorption ratio (SAR) of Colorado River water to be used by the Project is within the tolerance limit of crops grown. Boron concentrations are low and, therefore, have no effect on irrigated crops.

The average annual flow-weighted concentrations of several constituents of Colorado River water that will be used in the Project area are shown in Table I. Although the average annual TDS concentration shown in this table is below the Public Health Service Drinking Water Standard (1962) of 500 mg/l, the standard is exceeded eight months during the year (Figure 3).

A pollution study in the Upper Colorado River Basin was conducted in 1966 by the Technical Advisory and Investigations (TA&I) Branch and the Colorado River Basin Water Quality Control Project (CRBWQCP) of the FWPCA. The study indicated that iron and manganese concentrations in the reach of the Colorado River adjacent to the Project area consistently exceeded the recommended Public Health Service drinking water standards. The presence of these metals could increase treatment costs incurred by domestic and industrial water users.

Other water quality parameters of the Colorado River near the Project area studied by the TA&I Branch included dissolved oxygen (D.O.) and fecal coliform bacteria. The D.O. averaged about 7.3 mg/l, which exceeds the Colorado water quality standards. The geometric mean fecal coliform density ranged from 60 to 520 most probable number (MPN) per 100 milliliters. This is well within the limits of the Colorado water quality standards.

The minimum flow of the Colorado River at Sharrard Park required to assimilate the projected municipal and domestic load after treatment is 300 cfs. This flow will allow a D.O. concentration of 6.0 mg/l (Colorado water quality standards) to be maintained in the stream. The lowest flow recorded at the U. S. Geological Survey gaging station near Cameo, Colorado, the station nearest the Project area, has been 700 cfs, which is more than adequate to meet the minimum flow required for waste assimilation.

Salinity is the water quality parameter of major importance outside the Project area. The average annual present modified TDS concentrations at Cameo, Lake Mead, and Imperial Dam are about 425, 734 and 838 mg/l, respectively. The TDS concentrations at Lees Ferry on the Colorado River and all points downstream presently exceed PHS recommended limits for drinking water. Project development will cause an increase in these salinity concentrations.

Table I. Water Quality Data for the Colorado River near Cameo, Colorado[a/]

Constituent	Concentration (mg/l)
Calcium (Ca)	57
Magnesium (Mg)	13
Sodium (Na)	70
Potassium (K)	3
Bicarbonate (HCO_3)	146
Chloride (Cl)	93
Sulfate (SO_4)	97
Total Dissolved Solids (TDS)	425[b/]
Hardness as $CaCO_3$	198
Nitrate (NO_3)	1.9
Silica (S_1O_2)	11

a/ W. V. Iorns, C. H. Hembree, D. A. Phoenix, and G. L. Oakland, "Water Resources of the Upper Colorado River Basins - Basic Data," Geological Survey Professional Paper 442, 1964.(4)

b/ U. S. Department of the Interior, "Quality of Water, Colorado River Basin," Progress Report No. 4, January, 1969.(1)

With 100 percent control of the oil shale salt load, the annual salinity increase at Cameo will be 8 mg/l of which 6 mg/l and 2 mg/l result from M&I and irrigation water use, respectively. At Lake Mead, the annual salinity increase will be 2.8 mg/l, of which 2.1 mg/l and 0.7 mg/l result from M&I and irrigation water use, respectively.

ECONOMIC IMPACT

The use of Project water in the Sharrard Park area will cause an increase of about 6 mg/l in the salinity of the Colorado River above the Kobe Pumping Plant. However, since only 500 A.F. of water will be diverted annually from the Colorado at the Kobe Pumping Plant, the small increase in salinity at this location will have no significant economic impact in the Project area.

The annual increase in TDS at Cameo of 8 mg/l will have no significant economic impact between the Project area and Lake Mead because (1) the quantity of water used in this zone is small, and (2) the magnitude of this salinity increase in the range of mineral quality existing in this reach of the river will have very little effect on beneficial uses.

However, the 2.8 mg/l increase in salinity at Lake Mead resulting from use of Project water has a detrimental effect to all Colorado River water users below that point. Data developed by FWPCA's Colorado River Basin Water Quality Control Project indicate that a 2.8 mg/l annual salinity increase at Lake Mead will result in an average annual equivalent penalty cost of about $112,000. This figure is based on a 100-year period of analysis, beginning in 1968, at 4-7/8 percent interest rate. These figures include only the direct effects upon agricultural, municipal, and industrial water users below Hoover Dam.

III. WATER QUALITY CONTROL MEASURES

The Colorado River Basin states have established water quality standards, which have been adopted by the Secretary of the Interior. However, due to the complexity of the salinity problem in the Colorado River Basin, the establishment of numerical mineral quality criteria for the Basin's interstate waters has been delayed until sufficient information is available to assure that such standards will be equitable, workable, and enforceable.(5) Nevertheless, according to the Assistant Secretary for Water Pollution Control,(6) "It is the intention of the Secretary that the Department of the Interior and the states pursue active programs to lay the foundation for setting numerical criteria at some future time. These programs should focus on devising and demonstrating salinity control measures and finding ways to revise the legal and institutional constraints that could impede the implementation and enforcement of salinity standards."

In the interim before mineral quality standards are set and while salinity control measures are being investigated, certain general guidelines have been formulated(7) for use in evaluating water resource projects such as the Bluestone. These guidelines are summarized in the following statements:

1. Each proposed project must be examined for adverse effects on water quality.

2. State and Federal agencies must be made aware of the consequences of project development to water quality deterioration and of opportunities that may exist for better quality control on each project. All practicable means must be employed to prevent deterioration of existing mineral quality conditions.

3. Each project feature must be analyzed and justified in accordance with the principles outlined in Senate Document 97.

The information presented in this report has been developed to permit the proper evaluation of the Bluestone Project in accordance with the above guidelines.

STORAGE FOR STREAMFLOW REGULATION

Present and projected municipal, industrial, and rural organic waste loads within and below the Project area can be controlled with adequate treatment at the source. Thus, no storage in Mt. Logan Reservoir is needed to provide flow regulation for maintaining satisfactory organic water quality.

Mineral water quality will be degraded as a consequence of irrigation, municipal, and industrial uses served by water from this Project. This degradation has no significant economic impact in the Project area or between the Project area and Lake Mead. Therefore, no flow regulation for mineral quality control to protect uses above Lake Mead is necessary.

Below Lake Mead, mineral quality deterioration will cause downstream water users to suffer an annual economic loss estimated at $112,000, which clearly indicates the need to incorporate all possible water quality controls in the Project. The large volumes of water stored in both Lake Powell and Lake Mead result in the releases from Lake Mead being fairly uniform in mineral quality regardless of any seasonal or annual fluctuations in flow and quality of the Colorado River and its tributaries above the reservoirs. Therefore, any regulation of flow achieved by storage of presently available water in Mt. Logan Reservoir will not change the quality of water discharged from Hoover Dam unless the volume of water stored in Lake Powell and Lake Mead is drastically reduced.

In lieu of providing storage in Mt. Logan Reservoir for mineral quality control of Project-induced salinity increases below Hoover Dam, other salinity control measures within the Project area should be investigated. Any such measures found feasible should be included in the Project plan.

WASTE SOURCE CONTROL

Potential salinity control measures may be divided into two categories: water phase and salt phase. The former comprises possibilities for improving water quality by augmenting the water supply, while the latter includes prospects for improving water quality by reducing the salt input.

Several water-phase control measures appear to have some merit. Phreatophyte eradication on Project lands and along canals and drains could prevent loss of water and make more water available for dilution. It should be recognized, however, that phreatophyte eradication may result in loss of wildlife habitat and winter protection for cattle and sheep.

Conservation irrigation, the use of irrigation and cropping methods that best fit a particular soil, slope, crop, and water supply, is another measure which appears to offer possibilities for mineral quality improvement.

Installing closed conveyance systems or lining ditches and canals may result in higher delivery efficiencies and, consequently, improved water quality. Proper land preparation by grading and leveling also conserves water.

Potential salt-phase control measures include the careful selection of land to be irrigated and the provision of better land drainage. Those lands naturally high in alkaline or sodic salts should be eliminated from consideration in favor of soiis having low natural salt content. The initial leaching of irrigated lands can be hastened by installation of subsurface drainage systems adequately designed for salinity control. With installation of such a drainage system,the salt load over a number of years may be reduced.

The Federal Water Pollution Control Administration, the Bureau of Reclamation, and the Colorado River Basin states are developing a proposed salinity control program. The objective of this program will be to minimize future deterioration of the mineral quality of the Basin's water supply.

In order to minimize water quality problems associated with Project construction activities, the Bureau of Reclamation specifications should contain clauses making it the responsibility of the contractor to comply with all applicable federal, state, county, and local laws concerning pollution of rivers and streams. This will require the contractor to give careful attention to pollution problems such as disposal of sanitary wastes and production of sediment during construction.

It is anticipated that Mt. Logan Reservoir will provide diversified recreational opportunities, such as picnicking, camping, fishing and swimming, and boating. Recreational uses expected at the reservoir are potential sources of pollution that, if not properly controlled, could create local water quality problems both in the reservoir and in downstream reaches of Roan Creek. Sanitary waste disposal systems will be required at all recreational areas. In addition, facilities to receive and treat the contents of boat-waste holding tanks and containers should be provided at appropriate locations. Provisions should also be made to require that fuel-dispensing equipment on docks be provided with safety features that will prevent the accidental discharge of petroleum products to the reservoir. The essential features of waste disposal facilities for recreational areas should be submitted to the Federal Water Pollution Control Administration in the early stages of planning.

IV. CONCLUSIONS

1. No storage in Mt. Logan Reservoir is needed to provide flow regulation for maintaining satisfactory organic water quality.

2. The use of Project water in the Sharrard Park area will cause an increase of about 6 mg/l in the salinity of the Colorado above the Kobe Pumping Plant. However, since only 500 A.F. of water will be diverted annually from the Colorado at the Kobe Pumping Plant, the small increase in salinity at this location will have no significant economic impact in the Project area.

3. Municipal, industrial, and irrigation uses supplied by the Project-developed water will increase the salinity (total dissolved solids) concentration in the Colorado River at Lake Mead by 2.8 mg/l. This increase in salinity will result in an estimated direct average annual equivalent penalty cost of $112,000.

4. Regulation of flow achieved by storage of presently available water in Mt. Logan Reservoir will not change the mineral quality of water discharged from Hoover Dam unless the volume of water stored in Lake Mead and Lake Powell is drastically reduced.

5. Project construction activities and wastes generated by recreational activities may cause water quality degradation in the Mt. Logan Reservoir, the Colorado River, and Roan Creek unless adequate water pollution control measures are provided.

V. RECOMMENDATIONS

In order to prevent or minimize detrimental effects upon water quality, it is recommended that:

1. The best practicable water quality control measures be incorporated into the construction and development of the Project to minimize the adverse effects of salinity associated with the Project on downstream water uses.

2. The water-delivery contracts with oil shale industries that will use Project water contain a clause requiring 100 percent control of any salt-load wastes.

3. Provisions be included in construction specifications to assure that appropriate steps are taken by the contractor during Project construction to protect the quality of Roan Creek and the Colorado River.

4. Definite measures be taken to insure adequate treatment and disposal of wastes associated with recreational activities at the proposed Mt. Logan Reservoir.

VI. REFERENCES CITED

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3. University of Colorado, Bureau of Economic Research, for FWPCA, "Water Coefficients for the Mining Sectors of the Colorado River Subbasins," July, 1965.

4. W. V. Iorns, C. H. Hembree, D. A. Phoenix, and G. L. Oakland, "Water Resources of the Upper Colorado River Basin - Basic Data," Geological Survey Professional Paper 442, 1964.

5. Stewart L. Udall, Secretary of the Interior, statement before the Subcommittee on Irrigation and Reclamation, Committee on Interior and Insular Affairs, House of Representatives on Colorado River Basin Project Legislation, January 30, 1968.

6. Frank C. DiLuzio, Assistant Secretary of the Interior for Water Pollution Control, letter to the chairman, Technical Water Quality Standards Committee for the Colorado River Basin States, February 12, 1968.

7. Frank C. DiLuzio, Assistant Secretary of the Interior for Water Pollution Control, remarks before the Pacific Southwest Region Inter-Agency Committee, Las Vegas, Nevada, December 6, 1967.

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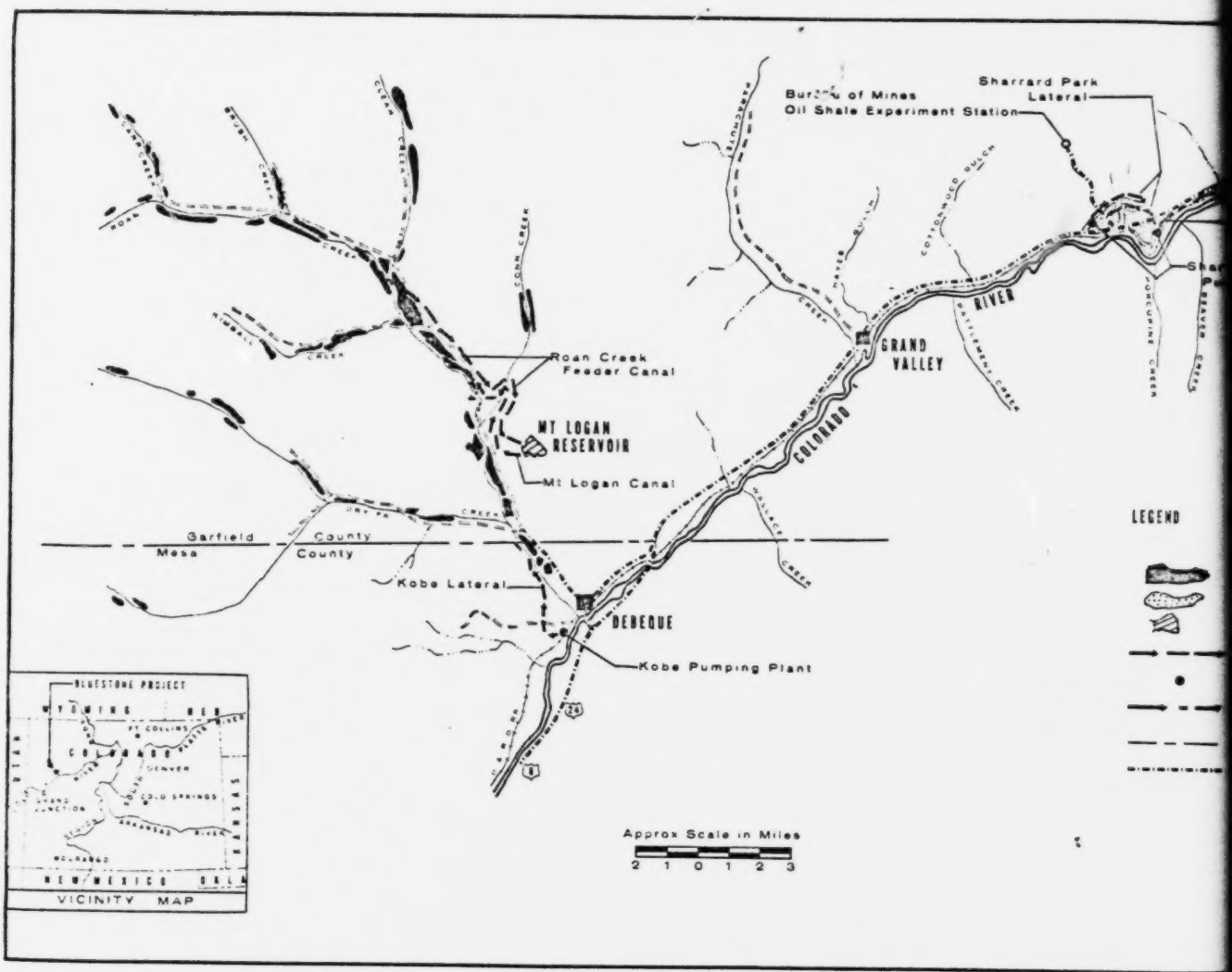

Figure 1. Location Map of

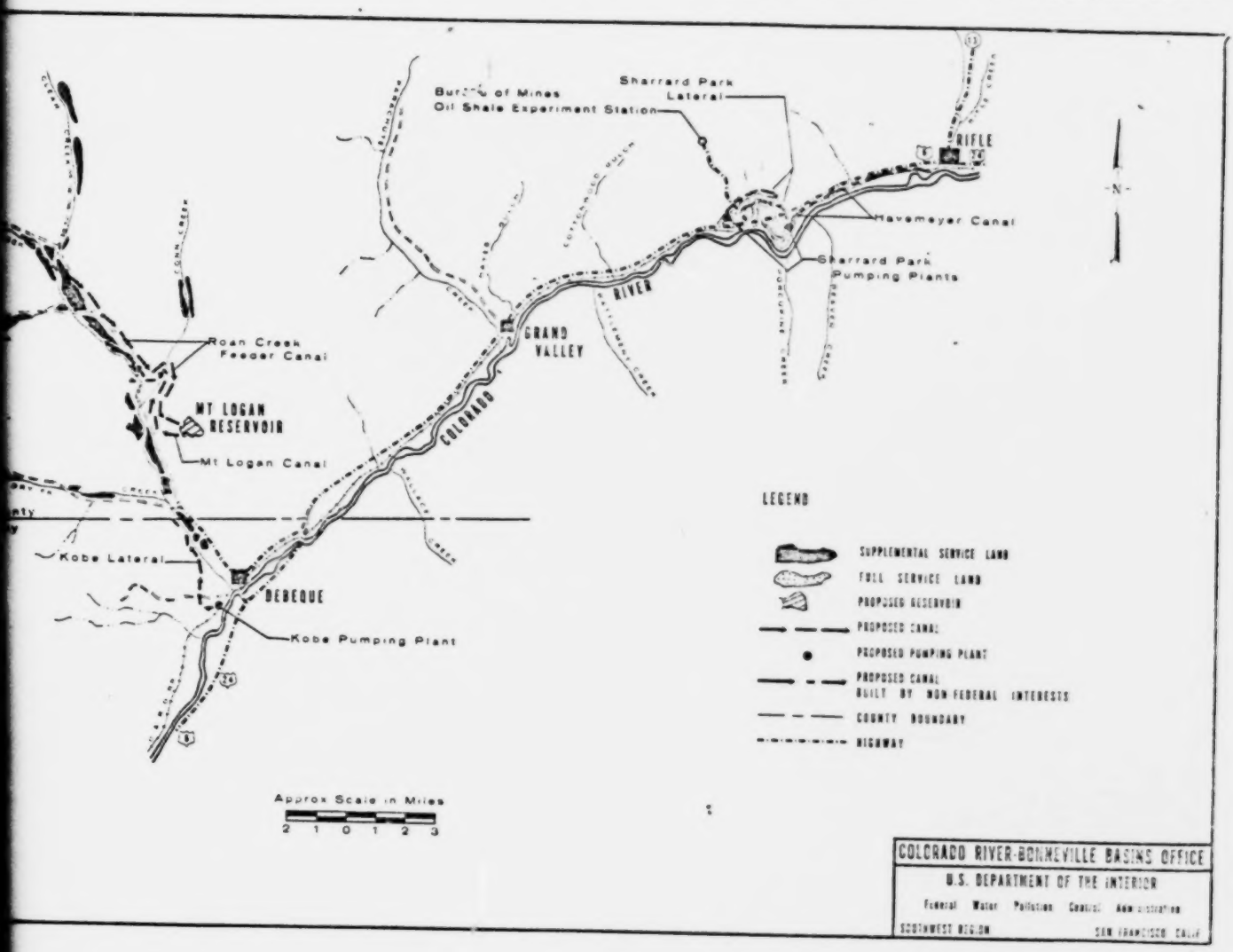

Figure 1. Location Map of Proposed Bureau of Reclamation Bluestone Project